

Application No. 09/880,649
Amendment Dated January 16, 2004
Reply to Office Action dated September 16, 2003

Remarks

Claims 1-13 have been canceled, new claim 15 has been added, and claims 14-15 remain in the application. Re-examination and reconsideration of the application are respectfully requested.

Claims 1-4 and 10-14 are rejected under 35 U.S.C. §103(a) as being unpatentable over Nojima (U.S. Patent No. 5,812,355) in view of Oyama et al. (U.S. Patent No. 4,878,147). The operation of the Nojima and Oyama et al. references are discussed in detail in Applicant's Amendment and Response dated July 29, 2003. Claims 1-4 and 10-13 have been canceled; and therefore, the following remarks relate to claim 14.

Claim 14 relates to a method of stabilizing the rate of current flow at the beginning of a peak current pulse by changing the magnitude of the effective voltage applied to the coil 14 (Fig. 1) from the power switch 18 as an inverse function of fluctuations in power supply voltage, page 8, lines 8-31. Under normal operation, as described at page 10, lines 4-24, a hysteresis modulator 74 modulates the operation of switch 48, so that current in the coil approximates the current model from the waveform generator, that is, a current having an initial peak magnitude followed by a hold magnitude. With the lowest power supply voltage, the PWM 37 (Fig. 3) is operating at a 100% duty cycle. The system control 12 provides a gun ON/OFF signal to AND 39 causing the AND 39 to gate the output of the hysteresis modulator 74 to the switch driver 76. As described at page 11, lines 7-34, the line voltage compensator 33 limits the output from the AND gate 39 as a function of the magnitude of the line voltage. More specifically, at the beginning of gun ON signal, if the line voltage compensator 33 detects a higher voltage, the duty cycle of the PWM 37 is proportionally reduced as an inverse function of the power supply voltage. By proportionally reducing the hysteresis modulator output that passes through AND gate 39, the leading edge of the peak current is modulated. Thus, the coil current increases at a rate represented by the curve 212 of Fig. 2B, which is approximately the same rate as with the lowest power supply voltage as represented by the curve 208 of Fig. 2A; and the

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solenoid is operated at the same speed as the lowest voltage, that is, at a speed independent of the power supply voltage changes.

In order to establish a prima facie case of obviousness, it is necessary that the Office Action present evidence, preferably in the form of some teaching, suggestions, incentives or inference in the applied prior art or, in the form of generally available knowledge, that one having ordinary skill in the art would have been led to arrive at the claimed invention.

A prima facie case of obviousness is not made because Nojima and Oyama et al. neither alone nor in combination disclose or suggest the invention of claim 14. Claim 14 requires

modulating a leading edge of the initial peak current with a duty cycle determined as an inverse function of the varying voltage of the unregulated power source; and

applying the initial peak current to the solenoid to operate the solenoid and the dispensing valve with an operational speed independent of the varying voltage of the unregulated power source.

That operation of Applicant's invention is described at page 11, line 14 through page 12, line 27 and is shown by the slopes 212 and 216 in Fig. 2B, which the invention maintains substantially identical to the slopes 208 and 214, respectively, of Fig. 2A.

As described at page 10, lines 12-24, the hysteresis modulator 74 of Fig. 3 provides output signals to connect coil 14 to the unregulated power supply 19 in response to coil current falling below a lower current limit and disconnects the coil 14 from the unregulated power supply 19 in response to the coil current exceeding an upper current limit. Thus, for a constant level at the output of waveform generator 16, the hysteresis modulator 74 continuously controls the magnitude of current in the coil independent of the fluctuations in the power supply voltage. The line voltage compensator 33 and the hysteresis modulator 74 work together to control the transition time between current levels, such as from zero amps to I_{pk} . By controlling this time, the actuation time of the solenoid is made consistent even when operated with an unregulated power supply.

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Oyama et al. pulse width modulates the switching element 5 with a duty cycle that varies in inverse proportion to the power supply voltage in order to provide a substantially constant current to the coil that is independent of changes in the power supply voltage. Such a function is similar to the function of the hysteresis modulator 74 of Fig. 3. Applicant submits that there is nothing in Oyama et al. to suggest modulating a leading edge of the closing pulse in order to hold the operational speed of the coil constant and independent of the power supply voltage.

A prima facie case of obviousness is not made because Nojima and Oyama et al. are directed to different problems than the claimed invention. Nojima is directed to providing a power supply that can be connected to a range of line voltages. As described in the "Description of the Prior Art", Oyama et al. is directed to an electromagnetic coil drive device that is used to drive electromagnetic switches or contactors and are operable with power supplies providing different voltages, for example, 100 V or 200 V. More specifically, Oyama et al. is directed to an improved driver circuit that is simpler and requires fewer parts than the prior art devices, col. 2, lines 18-24. Applicant submits that small variations in the operating speed of an electrical contactor do not adversely impact its performance.

In contrast, as described at page 2, line 15 through page 3, line 12, Applicant's claimed invention is directed to operating an electrically operated fluid dispenser, such that the operational speed of the gun is independent of voltage variations from the power source. Applicant's driver circuit is not intended to be operated with different power supplies. Instead, Applicant's driver circuit is intended to insulate the operational speed of the dispensing gun from normally occurring fluctuations in line voltage; however, in different seasons and in different countries, such fluctuations can be quite large. Further, as described in the application, absent the invention of claim 14, such fluctuations will alter the operational speed of the dispensing gun and change the accuracy with which material is deposited onto the workpiece.

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Applicant submits that there is nothing in Nojima or Oyama et al. that teaches, suggests or motivates one to provide a solenoid drive for a fluid dispenser that modulates a leading edge of the closing pulse in order to hold the operational speed of the coil constant and independent of fluctuations in the power supply voltage. Therefore, Applicant submits that claim 14 is patentable and not obvious under 35 U.S.C. §103(a) over Nojima in view of Oyama et al.

Claims 1-4 and 10-14 are rejected under 35 U.S.C. §103(a) as being unpatentable over Nojima in view of Ohtsuka. Again, the operation of Nojima is discussed in detail in Applicant's Amendment and Response dated July 29, 2003. Ohtsuka relates to an electromagnetic contactor that can be connected to different voltages and further, can control movement of a movable iron core in order to mitigate the physical impact of the movable core colliding with a fixed core. As described at col. 9, lines 20-30, a timer 16 (Fig. 3) is used to switch a pulse computing circuit from a higher current closing operation defined by the time period T_1 , of Fig. 6 to a lower current maintenance operation.

Referring to Fig. 2, current through a magnetic coil 120 of the contactor is controlled by the operation of switching elements 1 and 2. As shown in Fig. 6, the operation of switching element 1 is indicated by the curve (d); and the operation of switching element 2 is indicated by the curve (e). The resulting current in the coil 120 is illustrated by the curve (f). During the closing operation T_1 , if the pulse width modulation of the second switching element results in longer on-times as indicated by pulses g and h of curve (e), the magnitude of the current in the coil 120 increases as shown in curve (f). However, if the pulse width modulation of the second switching element 2 results in lesser on-times as indicated by pulses i and j, the resulting magnitude of current in the coil 120 is reduced. As will be described, the pulse widths of pulses from the second switching element 2 vary in accordance with particular operational conditions to provide a varying current magnitude within the coil 120 during a closing period having a duration T_1 .

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During the closing operation, the variation in pulse widths is described at column 13, lines 13-23. As shown in Fig. 4, a reference triangular wave curve G is provided by the reference triangular wave generating circuit 50 of Fig. 3. Reference levels P and Q are provided by the closing pulse computing circuit 17 depending on the magnitude of the applied voltage. For example, if the loaded voltage is lower, level Q provides an output H from comparator 83 with a larger duty cycle as indicated by the solid line in Fig. 4. But, if the loaded voltage is higher, level P provides an output H with a smaller duty cycle indicated by the dashed lines in Fig. 4. As shown in Fig. 5A, the pulses have a range of duty cycles of 32%-100% depending on the magnitude of the applied voltage.

As further described at col. 13, lines 24-40, during the closing period T_1 , if the iron cores have not collided as detected by the movable section displacement detecting section 109 and represented by an input from the closing pulse computing circuit 17, the movable section displacement computing circuit 19 drops the levels of P or Q around 30% as represented by the pulses i and j in wave form (e) of Fig. 6. Subsequently, after start of the collision of the iron cores, the original state of P or Q is restored to provide the pulses h in wave form (e) of Fig. 6. The reduction in pulse width of pulses i and j reduces the current in the coil 120 as shown at corresponding points in curve (f). Thus, it is possible to minimize an impact in the point contact or collision of iron cores as well as suppress the bounce of the movable section.

At column 13, lines 56-63, the switching from the closing operation to the maintenance operation is described as occurring upon the "output from the timer circuit 16 switching the pulse computing circuit (from circuit 17 to circuit 18) from closing to maintenance when a specified period from start of load of voltage until completion of closing." The specified period is represented by the period T_1 of curve (e) in Fig. 6.

Upon switching to the maintenance mode, the comparator 82 provides output pulses illustrated by curve I of Fig. 4 in a similar manner as previously described. As shown in Fig. 5B, the pulses have a range of duty cycles of

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3.2%-20% depending on the magnitude of the applied voltage. That reduced width pulse k of curve (e) of Fig. 6 results in a substantially constant, lower maintenance current through the coil 120 as shown in curve (f).

A prima facie case of obviousness is not made because Nojima and Ohtsuka neither alone nor in combination disclose or suggest the invention of claim 14, that is, modulating a leading edge of the initial peak current with a duty cycle determined as an inverse function of the varying voltage of the unregulated power source and thus, operating the solenoid and the dispensing valve with an operational speed independent of the varying voltage. That operation of Applicant's invention has been previously described.

As with Oyama et al., Ohtsuka pulse width modulates switches with a duty cycle that varies in inverse proportion to the power supply voltage in order to provide a substantially constant current to the coil that is independent of changes in the power supply voltage. Ohtsuka provides a reduction of the closing current during the closing period in response to an output from the movable section displacement detecting section 109. Further, at col. 15, lines 4-7, Ohtsuka describes the initial turn ON of the contactor operation by the providing an output g shown in curve (e) of Fig. 6. The output g applies full power to the coil to turn the coil on as quickly as possible, and the output g is maintained until the coil current reaches its desired magnitude as shown in curve (f) of Fig. 6. Applicant submits that there is nothing in Ohtsuka to suggest modulating a leading edge of the closing pulse in order to hold the operational speed of the coil constant and independent of fluctuations in the power supply voltage.

A prima facie case of obviousness is not made because Nojima and Ohtsuka et al. are directed to different problems than the claimed invention. Nojima is directed to providing a power supply that can be connected to a range of line voltages. Ohtsuka is directed to providing an electrical contactor that can be connected to different voltages and can mitigate the physical impact of the movable core colliding with a fixed iron core. Again, applicant

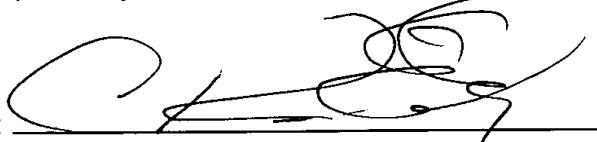
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submits that small variations in the operating speed of an electrical contactor of Ohtsuka do not adversely impact its performance. As previously discussed in detail, the invention of claim 14 is directed to operating an electrically operated fluid dispenser such that the operational speed of the gun is independent of voltage variations in the power source.

Applicant submits that there is nothing in Nojima or Ohtsuka that teaches, suggests or motivates one to provide a solenoid drive for a fluid dispenser that modulates a leading edge of the closing pulse in order to hold the operational speed of the coil constant and independent of the power supply voltage. Therefore, Applicant submits that claim 14 is patentable and not obvious under 35 U.S.C. §103(a) over Nojima in view of Ohtsuka.

Applicant submits that the application is now in condition for allowance and reconsideration of the application is respectfully requested. The Examiner is invited to contact the undersigned in order to resolve any outstanding issues and expedite the allowance of this application.

Respectfully submitted,

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